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HUMAN RESOURCES, HIGHER EDUCATION AND THE EXPANDING ECONOMY

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled HUMAN RESOURCES, HIGHER EDUCATION AND THE EXPANDING ECONOMY submitted by Conrad J. Dickhoff in partial fulfilment of the requirements for the degree of Master of Arts.

ABSTRACT

In recent years economic growth and the varying forces which cause growth have drawn much attention in the literature. In this investigation, contributing variables of the aggregate production function are examined to determine the major sources of output growth. The "residual" factor (technical change) is a large and unexplained element in observed growth. Using an expanded and adjusted list of inputs, it is possible to account for more of the observed growth in output. Most of the increased explanation can be accounted for by substantial economies of scale and "advances in knowledge". The present paper contends that human resource development, particularly as indicated by formal higher education, has been a heavy contributor to growth, although admittedly only one of several tangible and intangible productive inputs. Moreover, such Canadian studies as have been done corraborate the results of investigations carried on in the United States of America.

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CHAPTER I

INTRODUCTION

Much has been written on economic growth in recent years and on the varying forces which may cause one economy to grow more quickly than another. One of the main hypothesized determinants of economic growth is tangible capital. The truth could be that the mere accumulation of capital is less instrumental to growth than we presently believe and that the "human factors"--technical progress, organization, and education--are a form of human capital and contribute much more than we realize.

Accordingly the opening chapter investigates the underlying forces which may cause economic growth. Capital, both tangible and human, are contributing factors. Chapter II is a critical review of present economic analytic methods of evaluating the contribution of education to the economy. Chapter III estimates lifetime earnings and education to support the hypothesis that higher education has paid significant returns, both private and social. The conceptual problems in human measurement are discussed in Chapter IV, while Chapter V is concerned with the limitations in assessing the contribution of the human factor in economic growth as well as the

need for future research. Chapter VI brings together the main conclusions.

Economic Theory Vis-a-Vis Empirical Studies

Economic analysis has traditionally assumed that GNP represents the combined output of land, labor, capital, and entrepreneurship. Until recently it was taken more or less for granted that the stock of capital was crucial. Simplified models of growth quite often postulated constant proportionality between capital and output and assumed that output in the long run would grow pari-passu with the capital stock. To the policy-maker this meant that higher investment levels were the obvious way to quicker growth.

Empirical studies, however, indicated that only a part of the increased output per man could be ascribed to increased input of capital and suggested that productivity improvements played a crucial role. Among the concepts of productivity which have gained popularity in recent years, two approaches can be distinguished: that of Solow[1] and that of the National Bureau of Economic Research, as exemplified

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[1] R. M. Solow, "Technical Change and the Aggregate Production Function," Review of Economics and Statistics, XIL (August, 1957), 312-20.

by Kendrick.[2] Both approaches measure productivity's contribution as the residual between the increase in output actually observed during a given period and that which would have been expected due to an increase in factor inputs alone. Both methods build into the empirical model the twin restrictive assumptions of constant returns to scale and competitive factor pricing. Differences between the two measures of productivity may originate from the weighting system used to estimate the residual. Solow introduces base period weights and uses the geometric weighting scheme, thereby assuming the underlying production function to be of the Cobb-Douglas type, while Kendrick measures both output and input in constant prices and uses the arithmetic scheme of weighting the inputs for aggregation, thereby assuming an infinite elasticity of substitution among the inputs.

Mr. Kendrick concluded that for the period 1899 to 1957 increased inputs of labor and capital could explain only about one-half of the growth of the national product.

In another study, Schultz has shown that between 1919 and 1957 output increased at an annual average rate of 3.1 percent, while inputs of labor and physical capital increased by only 1.0 percent per year.

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[2]John W. Kendrick, Productivity Trends in the United States (Princeton: National Bureau of Economic Research, Princeton University Press, 1961).

TABLE 1

INCREASES IN OUTPUT AND INPUTS OF THE PRIVATE DOMESTIC SECTOR OF THE UNITED STATES ECONOMY, 1919 TO 1957

	1919 (Indexes 1929 = 100)	1957	Increases % per annum
Output	69.7	225.2	3.1
Input			
Labor Input	86.7	116.9	0.8
Capital Input	80.3	158.2	1.8
Total (weighted by relative shares)	84.9	125.5	1.0

Source: T. W. Schultz, "Education and Economic Growth," in Social Forces Influencing American Education, ed. Nelson B. Henry (Chicago: University of Chicago Press, 1961), p. 50.

Assuming no significant economies of scale, this leaves about two-thirds of the growth in output unaccounted for by changes in inputs. What factors contributed to the other or residual part of the growth of the GNP? Was it "technological advance" and if so (i) what is its quantitative role, and (ii) which factors ultimately determine the rate of this technical advance?

Production Functions

Attempts have been made to design a growth formula or production function which will describe in quantitative

terms the way in which the input of capital and labor and the level of technique determine the output potential of a society.

Professor Solow's 1957 paper attempts to distinguish between the effects of factor substitution (embodied technical progress) and the shift in the production function (disembodied technical progress) in the process of technological change.[3] Solow used a Cobb-Douglas constant returns to scale production function with an exponential time trend, showing the relationship at time t between output, Y(t); capital input, K(t); and labor input, L(t):

$$Y(t) = e^{\mu t} K(t)^{a} L(t)^{1-a}$$

where μ is disembodied technical progress, a is the elasticity of output with respect to capital, and 1-a is the elasticity of output with respect to labor. Disembodied technical progress represents output increases realized by reorganization of industry rather than increases in factor inputs and is measured by shifts in the production function.[4] Disembodied technical progress was estimated as approximately one percent annually from 1909 to 1929 and two percent annually from 1929 to 1949.[5]

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[3] Solow, op. cit.,

[4] Ibid., p. 313.

[5] Ibid., p. 318.

An example of the Cobb-Douglas production function supplemented with a trend component showing the relationship between output, 0; capital input, K; and labor input N is:

$$0 = cK^a N^b E^{zt}$$

where $a + b = 1$, and c, a, b, and z are constants.[6] This function assumes that the growth rate of output $\frac{\Delta 0}{0}$, capital $\frac{\Delta K}{K}$ and labor $\frac{\Delta N}{N}$, measured as annual percentage increases, are related to each other such that:

$$\frac{\Delta 0}{0} = a\frac{\Delta K}{K} + b\frac{\Delta N}{N} + z$$

where $a + b = 1$ and are constants, and where z, a residual, can be taken to represent the annual percentage increase in output due to technical progress.

If we assume that z is a constant (this means assuming that technical progress advances at a constant rate over time) it is possible from historical records of output, labor and capital to estimate the constants a, b, and z by econometric methods.

The estimates of the capital and labor coefficients of the production function for Norway and West Germany result in coefficients that are somewhat below and above unity due to

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[6] Odd Aukrust, Factors of Economic Development: A Review of Recent Research (Oslo: Working Paper from the Central Bureau of Statistics of Norway, 1963).

TABLE 2

ESTIMATES OF THE COEFFICIENTS OF THE COBB-DOUGLAS PRODUCTION FUNCTION WITH A TREND COMPONENT FOR FOUR COUNTRIES

	% increase of output by 1% increase of capital	% increase of output by 1% increase of labor	Trend ascribed to technical progress
Norway (1900-1955) (Total economy)	0.20	0.76	1.8
United States (1909-49) (Private non-farm activity)	0.35	0.65	1.5
Finland (1925-52) (Industry)	0.26	0.74	1.2
West Germany (1925-57) (Total Economy)	0.34	0.76	1.9

Source: Odd Aukrust, Factors of Economic Development: A Review of Recent Research (Oslo: Working Paper from the Central Bureau of Statistics of Norway, 1963), p. 17.

possible sources of bias. For example, differences in the quality of labor in different countries would bias the estimated coefficient downward.[7] The resulting estimates, however, are not significantly different from unity.

[7] Zvi Griliches, "Research Expenditures, Education, and the Aggregate Agriculture Production Function," AER, LIV (December, 1964), p. 962.

The results from Table 2 are very close. For the United States, a one percent increase of capital has been found to increase output by 0.35 percent; a 1 percent increase of the labor force has increased output by 0.65 percent. Technical advance contributed 1.5 percent to the annual growth of total output and since the growth rate in the United States between 1929-1959 has been about 3 percent,[8] this means that about one-half of total growth has been caused by technical improvements. The trend component, z, constitutes a random variable and includes all the influencing forces (one of which is technological change) not included explicitly as systematic variables in the equation. This conclusion confirms Mr. Kendrick's findings. Once again how do we account for the residual element of growth not explained in terms of labor and capital?

Capital embodied technical progress defined as output increases realized by improved quality of factor inputs (both labor and capital) is measured by weighting capital and labor input indices for quality changes.[9]

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[8] Odd Aukrust, op. cit., Table 2, p. 16.

[9] R. M. Solow, "Investment and Technical Progress," in K. J. Arrow, L. Karlin, and P. Suppes, ed., Mathematical Methods in the Social Sciences (Stanford: Stanford University Press, 1959), 89-104.

Solow in his 1959 paper used vintage productions, that is, for each vintage v of capital he assumed a Cobb-Douglas constant returns to scale production function showing the relationship at time t between output produced by capital of vintage v, $Y(v,t)$; the surviving capital of vintage v, $K(v,t)$; and labor working with capital of vintage v, $L(v,t)$:

$$Y(v,t) = A\, e^{\lambda v}\, K(v,t)^{a}\, L(v,t)^{1-a}$$

where λ is capital embodied technical change and a and 1-a are the elasticities of output with respect to capital and labor respectively. Capital embodied technical change, λ, was estimated as .025, i.e., capital was improving at the rate of 2½ percent annually.[10]

Disembodied and embodied technical progress were measured in Solow's 1962 paper using a production function in which cyclical factors are considered explicitly by introducing into the estimation the unemployment rate, u.[11] The disembodied technical progress production function led to an estimate of disembodied technical progress of 2½ percent

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[10] Ibid., p. 94.

[11] R. M. Solow, "Technical Progress, Capital Formation, and Economic Growth," AER, Papers and Proceedings, (May, 1962), 76-86.

annually. The capital embodied technical progress production function was estimated indirectly and gave an annual estimate of capital embodied technical change, equal to 2-3 percent, for plant and 4 percent for equipment.

If disembodied and embodied technical progress are each improving capital at a rate of approximately 2½ percent annually one may reasonably infer that efficiency and quality improvements have accounted for a substantial amount of the growth in aggregate output during the past half century.

Denison endeavors to measure the qualitative differences in inputs and their respective contribution to aggregate output.[12] In its very broad lines, Denison's method is similar to Kendrick's. Denison, however, attempts to split open the residual (that part of the growth in output unaccounted for by changes in inputs) by making allowance for the effects of changes in various kinds of market restrictions on the movement of productivity, for economies of scale and for the advance of education and knowledge.

Becker, in attempting to measure the plausible contribution of education to technical progress, directly approaches the problem.[13] He endeavors to ascertain the money rate of

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[12]Edward F. Denison, The Sources of Economic Growth in the United States and the Alternatives before Us (New York: Committee for Economic Development, 1962).

[13]Gary S. Becker, Human Capital (New York: NBER, 1964).

return to college and high school education in the United States.

Both Houthakker[14] and Miller[15] have done specialized studies which are indicative of the extent to which productivity is related to education by assuming that earnings are an accurate reflection of productivity and comparing the earning streams of individuals with various amounts of education.

The Puzzling Residual

We have looked at some evidence suggesting that there are important factors of growth--besides labor and capital, per se--hiding within the residual construct. We have referred to these factors of growth as "technical progress," "organization," and the "human factor" and have implied that they contribute to productivity. Behind many of the factors contributing to productivity increase we shall find a continually recurring ingredient: improved human competence. Further, since human competence is a result of education, training and research, the presumption is strong that these activities are important considerations influencing technical progress.

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[14] H. S. Houthakker, "Education and Income," Review of Economics and Statistics, XLI (February, 1959), 24-28.

[15] H. P. Miller, "Annual and Lifetime Income in Relation to Education: 1939-1959," AER, L (December, 1960), 962-86.

CHAPTER II

HUMAN CAPITAL AND ITS MEASUREMENT

The following is a critical review of the problem, complexity, limitations and advantages of present economic analytic methods of evaluating the contribution of education to the economy. Three main approaches have been tried and will be reviewed in turn: (1) the simple correlation approach, (2) the residual approach, and (3) the returns to education approach.

The Simple Correlation Approach

This approach consists of correlating an index of educational activity with an index of the level of economic activity. The index of educational activity would measure either (1) the proportion of the total population in university and GNP/capita, or (2) the relation of the amount of GNP spent on education to the total GNP.

Some Preliminary Data for Canada

Table 3 shows the increase in university participation rates where enrolment is calculated as a percentage of the regional and national population in the 18-24 age group.

What are significant are the comparative increases of this rate within the region not the comparisons of the rates between regions. This is due, primarily, to the differences in the definition of a university student in the various regions and also to the length of the high school or secondary school course. The range of participation rates within each region has varied from a virtual doubling in Ontario to a tripling in the Prairies with the country as a whole more than doubling from 4.2 to 9.2 percent of the 18-24 age group.

TABLE 3

UNIVERSITY PARTICIPATION RATES 1951-1964
UNIVERSITY ENROLMENT AS A PERCENTAGE OF THE PROVINCIAL POPULATION, 18-24 AGE GROUP

	1951-2	1956-7	1961-2	1962-3	1963-4	1964-5
Atlantic Provinces	3.7	4.7	7.2	7.5	7.7	8.2
Quebec	4.4	5.2	7.9	8.4	9.0	9.5
Ontario	4.4	4.8	6.5	7.0	7.7	8.4
Prairies	3.4	4.3	7.4	8.1	8.9	9.9
British Columbia	5.5	6.8	10.8	11.0	11.5	11.6
Canada	4.2	5.0	7.5	8.0	8.6	9.2

Source: Commission on the Financing of Higher Education in Canada, Financing Higher Education in Canada, A Report Prepared for the Association of Universities and Colleges of Canada (Toronto: University of Toronto Press, 1965), Table 1 p. 13.

Table 4 shows the actual university enrolment by region and the distribution between undergraduate and graduate students for Canada in 1964.

TABLE 4

UNIVERSITY ENROLMENT BY REGION 1964-65
(Thousands)

Atlantic Provinces		17.7
Quebec		59.4
Ontario		50.8
Prairies		31.7
British Columbia		18.6
Canada		178.2
Undergraduate	164.4	
Graduate	13.8	
Total		178.2

Source: Commission on the Financing of Higher Education in Canada, Financing Higher Education in Canada, A Report Prepared for the Association of Universities and Colleges of Canada (Toronto: University of Toronto Press, 1965), Table 2, p. 16, and Table 3, p. 18.

Table 5 indicates that the total expenditures of universities increased from $88 million in 1954-55 to an estimated $537 million in 1964-65, a six-fold increase. On the other hand, GNP in current dollars approximately doubled from $24,871 million to $47,003 million.

The relative proportion of higher education expenditures to GNP has still remained at less than 1 percent of GNP in the ten year period.

If a positive relation exists between educational activity and GNP, the question then arises as to what cause and effect relationship is bound up in education-GNP correlations. For the answer to this question we must use an alternative approach.

TABLE 5

OPERATING, CAPITAL, AND TOTAL EXPENDITURES OF UNIVERSITIES AND COLLEGES OF CANADA (INCLUDING SPONSORED RESEARCH), 1954-55 TO 1964-65
(Millions $)

Academic Year	Operating Expenditure	Capital Expenditure	Total Expenditure	GNP	% Total Expenditure GNP
1954-55	76	12	88	24,871	.0035
1955-56	80	16	96	27,132	.0032
1956-57	87	20	107	30,585	.0034
1957-58	103	40	143	31,909	.0043
1958-59	121	52	173	32,894	.0052
1959-60	143	69	212	34,915	.0067
1960-61	176	79	255	36,284	.0075
1961-62	206	85	291	37,471	.0082
1962-63	239	113	352	40,561	.0084
1963-64	284	145	429	43,180	.0091
1964-65	337	200	537	47,003	.0114

Source: Columns 1 to 4, Table 7, p. 23, Commission to the Association of Universities and Colleges, Financing Higher Education in Canada. Column 5, DBS, National Accounts Income and Expenditure, 1964.

The Residual Approach

This method of analysis consists of taking the total increase in economic output or GNP over a given period of time, identifying as much of the total increase as possible with the measurable inputs of capital and labor, and then concluding that the residual is attributable to some unspecified inputs.[16] It is generally conceded that increases in education, skill and technological advances are the more important of the unspecified inputs. However, the heterogeneity of the factors that go to make up the residual means that a large residual cannot safely be interpreted as a sufficient reason for more spending on any particular factor to the exclusion of the others. The size of the residual does serve to focus attention and research to ascertain the economic effects of the neglected contributing factors of education, skill and technolgocial advances.

Alternative Techniques of the Residual Approach

John W. Kendrick of the National Bureau of Economic Research has used this approach in an endeavor to determine productivity trends in the United States.[17] He has found

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[16] Supra, p. 2.

[17] Kendrick, op. cit.

TABLE 6

ALLOCATION OF GROWTH RATE OF REAL NATIONAL INCOME AMONG THE SOURCES OF GROWTH

	Percentage points in Growth Rate		
	1909-29	1929-57	1909-57
1. Real National Income	2.82	2.93	2.89
2. Increase in total inputs	1.63	.92	1.22
3. Labor input (unweighted man hours)	.88	.47	.65
4. Employment	1.11	1.00	1.06
5. Hours	-.23	-.53	-.41
6. Capital	.75	.45	.57
7. Increase in output/unit of input (The Residual)	1.19	2.01	1.67
8. Ratio: 7 ÷ 1	.42	.69	.58
9. Increase in total input (Kendrick)	1.96	1.10	1.46
10. Output per unit of input (1-9) (The Residual)	.86	1.83	1.43
11. Ratio: 10 ÷ 1	.31	.62	.50

Source: Moses Abramovitz, "Economic Growth in the United States--A Review Article," AER, LII (September, 1962), p. 765.

that for the United States economy, over the period 1899 and 1957, the combined input index increased at an average rate of 1.9% per annum and the output index increased at about 3.5% per annum, leaving a "residual" increase of about 1.6% per annum (called by Kendrick the increase in "total factor

productivity"). Thus, 46% of the increase in total output is ascribed to the residual.

Denison's method is similar to Kendrick's, but Denison attempts to split open the residual by making allowance for the effects of changes in various kinds of market restrictions on the movement of productivity, for economies of scale, and for the advance of education and knowledge.[18]

Table 6, lines 1-8 shows the outcome of Denison's analysis as it would have appeared had he stopped at the same stage as Kendrick did. It shows the very large part of total output that remains to be explained by the residual when the only inputs accounted for are capital and undifferentiated man-hours. For comparison, lines 9-11, provide figures based on Kendrick's input calculations and Denison's national income estimates. The difference between the two estimates of the Residual is not large.

By contrast Table 7, in which Denison summarizes his own work, reveals some striking differences. Most prominent is the large reductions in the apparent importance of the increase in output per unit of input (the residual) to under half its former size (.93 compared to 2.01 percentage points). Three adjustments in labor input account for the bulk of the

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[18]Denison, op. cit.

TABLE 7

ALLOCATION OF GROWTH RATE OF REAL NATIONAL INCOME AMONG THE SOURCES OF GROWTH

	Percentage Points in Growth Rate	
	1909-29	1929-57
Real national income	2.82	2.93
Increase in total inputs	2.26	2.00
Labor input, adjusted for quality	1.53	1.57
Employment	1.11	1.00
Hours	-.23	-.53
Effect of shorter hours on quality	.23	.33
Education	.35	.67
Increased experience and better use of women	.06	.11
Changes in age-sex composition of labor force	.01	-.01
Capital input	.73	.43
Nonfarm residential structures	.13	.65
Other structures and equipment	.41	.28
Inventories	.16	.08
U.S. owned assets abroad	.02	.02
Foreign assets in U.S.	.01	.00
Increase in output per unit of input	.56	.93
Restrictions against optimum uses of resources	NA	-.07
Industry shift from agriculture	NA	.05
Advance of knowledge	NA	.58
Change in lag in application of knowledge	NA	.01
Economies of scale-independent growth of local markets	NA	.07
Economies of scale-growth of national market	.28	.27
Reduced waste in agriculture	NA	.02

Source: Edward F. Denison, The Sources of Economic Growth in the United States and the Alternatives Before Us. (New York: Committee for Economic Development, 1962), Table 32, p. 266.

change. Two large adjustments are made to allow for the alleged effects of shorter hours and of the rise in the level of education upon the quality of labor input per hour worked. A third, smaller, adjustment takes account of the fact that women in the labor force have come typically to represent a more experienced group employed at work which makes better use of their talents. The residual, moreover, has seven different parts. The two largest of which are "economies of scale" and "advance of knowledge."

If we re-arrange the data as in Table 8, we get a bird's eye view of the contributing sources of growth as being education and research, labor, capital, economies of scale and the residual.

Denison ends up with a residual that is very much smaller than previous ones, but as noted earlier, he has made separate estimates of the contributions of factors which have been included in the residual category by other authors. And, in making his estimate of the "advance in knowledge" he simply subtracts the rate of growth attributable to all the other inputs he identifies from the total rate of growth. This constitutes a residual within "The Residual" and is not in any sense a measure of "advance of

TABLE 8

ALLOCATION OF GROWTH RATES OF TOTAL REAL NATIONAL INCOME AMONG THE SOURCES OF GROWTH 1929-1957

	Percentage Points in Growth Rate	
Increased employment (Net effect of more man-years, shorter hours, and changes in composition of labour force)		0.90
Increased use of capital		0.43
Education and Research:		
Better educated labor force	0.67	
Advance of knowledge	0.58	1.25
Economies of scale:		
Growth of national market	0.27	
Independent growth of local markets	0.07	0.34
Other factors:		
Change in lag of applications of knowledge	0.01	
Reduced waste of labor in agriculture	0.02	
Industry shift from agriculture	0.05	
Restriction against optimum use of resources	-0.07	0.01
Total growth rate		2.93

Source: Edward F. Denison, The Sources of Economic Growth in the United States and the Alternatives Before Us. (New York: Committee for Economic Development, 1962), p. 266.

knowledge" alone.[19] For, as a residual, it is the grand legatee of all the errors of estimate.

[19] Moses Abramovitz, "Economic Growth in the United States--A Review Article," AER, LII (September, 1962), p. 775.

The residual approach has two main defects viewed from the standpoint of a desire to know something about the economic contribution of education.[20] First, the available indices of capital inputs fail to reflect improvements in the quality of capital. Consequently, the "true" contribution of physical capital is likely to have been somewhat greater than the figures given earlier suggest, ipso facto, the "true" size of the residual correspondingly smaller, the second, and more general difficulty is the "residual" nature of the residual. It encompasses changes in output attributable to quality changes, to economies of scale, to improvements in health of the labor force, to informal as well as formal education, to changes in the product mix, and to other factors. Moses Abramovitz has called it a "measure of our ignorance."

The Direct Returns-To-Education Approach

Education and Earnings

The extent to which productivity is related to education can be seen by assuming that earnings are an accurate reflection of productivity and comparing the earning streams of individuals with various amounts of education.

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[20] William G. Bowen, Economic Aspects of Education: Three Essays. (Princeton: Princeton University Press, 1964), p. 12.

Following Miller's format some Canadian figures have been compiled with respect to education and annual earnings.[21]

Table IX clearly shows that average income at each age class are strongly related to education. The table also shows that incomes tend to be relatively low at the beginning of labor force participation, rise throughout later ages until a peak is reached in the 45-54 age class, and decline in the last age class. The data does indicate that the proportional drop in income after age 64 is much more severe for the less educated.

Also worthy of note in the age class 15-24 years is the discrepancy in income which, in part, can be attributed in the secondary and university classification as being low due to the fact that some cohorts are still in school and are only in the labor force in the summer recess. In contrast, practically all men 25 years and over are full-time workers and it can therefore be assumed that any advantages that may accrue from more schooling are reflected in their incomes.

The data shows an income difference of 43 percent between male high school and college graduates 25-34 years old, and a 72 percent difference of the same group 35-44 years. This income difference is 78 percent in the age class 45-54. Thus the college graduate of any given age not only earns more

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[21]Miller, op. cit., p. 962-86.

TABLE 9

AVERAGE TOTAL INCOME FOR THE NON-FARM POPULATION, MALE AND FEMALE BY AGE AND YEARS OF EDUCATION
1961

Canada	Average Dollars	15-24	25-34	35-44	45-54	55-64	65-69	70
		$	$	$	$	$	$	$
No School								
Male	1,715	1,426	1,786	2,036	2,176	2,141	1,609	1,123
Female	888	1,072	953	972	1,015	966	845	811
Elementary								
Male	3,134	1,854	3,415	3,834	3,742	3,396	2,412	1,644
Female	1,247	1,115	1,516	1,510	1,445	1,273	992	954
Secondary (1-3 years)								
Male	3,943	1,966	4,271	4,857	4,912	4,637	3,669	2,473
Female	1,589	1,351	1,768	1,718	1,780	1,771	1,497	1,247
Secondary (4-5 years)								
Male	4,825	2,150	4,886	6,019	6,397	6,136	4,651	3,532
Female	2,080	1,741	2,216	2,179	2,397	2,416	2,106	1,796
Some University								
Male	4,995	1,711	5,179	6,888	7,229	7,012	5,543	4,153
Female	2,535	1,681	2,584	2,731	3,149	3,241	2,324	2,891
University Degree								
Male	9,048	3,055	6,994	10,355	11,430	11,425	9,605	6,188
Female	3,384	2,362	3,149	3,468	4,037	4,294	3,365	2,592

Source: DBS, 1961 Census of Canada, Population Sample: Incomes of Individuals, Vol. IV, Table A.11, p. 11-1.

than persons of the same age with less education, but the earnings of the college graduate exceed those of other persons to a greater extent as he grows older. In other words, the college graduate is increasingly advantaged with respect to earnings as he grows older. All age groups of male cohorts who had attended university but did not graduate had an average income $170 higher than did high school graduates who had never attended university, the male cohorts who had completed college had an average income $4,053 higher.

The figures in Table 9 point to the general conclusion that there exists a definite correlation between annual income and education and that this differential becomes more pronounced the higher the level of education and widens as the cohorts age.

Table 10 indicates more clearly the relation between schooling and the average amount of annual income where a progressive increase in income is correlated with each level of schooling. The average income and education relationship for females is distorted since a large proportion of women do not enter the labor market and many of those who do are employed on a part time basis only.

Do earnings measure productivity.--The social product approach is based on the premise that in a market economy

TABLE 10

AVERAGE TOTAL INCOME FOR THE NON-FARM POPULATION, MALE AND FEMALE, BY YEARS OF EDUCATION 1961

Canada	Average Dollars
No School	
Male	1,715
Female	888
Elementary	
Male	3,134
Female	1,247
Secondary (1-3 years)	
Male	3,943
Female	1,589
Secondary (4-5 years)	
Male	4,825
Female	2,080
Some University	
Male	4,995
Female	2,535
University Degree	
Male	9,048
Female	3,384

Source: DBS, 1961 Census of Canada, Population Sample: Incomes of Individuals, Vol. IV, Table A9, p. 9-1.

differences in earnings reflect differences in productivity. Is this a valid assumption? In an economy where relative earnings are determined via the market place, one might expect to find relatively high earnings being paid to

individuals possessing special training and skills which permit them to make a greater economic contribution than the average person.[22] However, there are imperfections in the market place and earnings need not always reflect marginal productivities, as witnessed by football players and movie stars; the distortions caused by these other cultural considerations on rates of return figures must be examined.

Cultural considerations and earnings.--The economist implicitly or explicitly makes the assumption that the entrepreneur pursues profit-maximizing behavior thereby ensuring earnings will reflect marginal productivity. "Conspicuous production" refers to the situation where employers choose to hire university graduates and pay them accordingly for jobs which do not require such training. The "rationale" supposably is to impress ones clients or competitors of the "brain trust" guiding company policy.

Another cultural consideration of non-profit-maximizing behavior of industry is where the salary is paid for consideration of status rather than productivity. When the bank clerk becomes assistant manager he is supposed to reflect his higher managerial position and status of "banker" by his modus vivendi. An ever increasing prerequisite for management status is a university degree. To the extent that business pays higher

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[22] Infra, p. 63.

earnings because of status overtones, calculations of monetary returns to education can be very misleading.

Prestige or non-monetary attractions of jobs require consideration in so far that wage structures will likely adjust so that "less pleasant" jobs will require higher wages than "more pleasant" jobs which require the same kinds of qualifications. In addition as our society becomes more affluent the prestige symbol of the "white collar" will tend to become more ingrained in our culture.

The question is: how should one adjust rates of return in consideration of prestige factors in (1) the private product or personal profit orientation, and (2) the social product or the national productivity orientation?

Prestige factors do accrue to individuals and increase their welfare. This being the case we could add some arbitrary monetary sum to earnings to estimate the dollar value of the non monetary advantages thereby increasing return to investment figures.

From the social product point of view more people will be prepared to work in the "more pleasant" jobs than in the "less pleasant" jobs and will increase the supply of labor available to these industries thereby lowering

wages. It should be noted that this phenomenon holds more emphatically if an elastic labor supply faces the industry. For if an inelastic supply curve did, in fact confront the industry there would not likely be the available substitutes in sufficient numbers to compete for any given vacancy. If this argument holds then there need be no adjustment for prestige factors in calculating return rates of investment in education by the social product approach for these prestige factors tend to be considered as inducements to jobs in lieu of monetary incentives.

CHAPTER III

EDUCATION AND LIFETIME EARNINGS

In attempting to measure lifetime earnings, the ideal would be to have life cycle data on a group of individuals. In the absence of such data Miller has constructed some estimates on the basis of summing the annual earnings at each age multiplied by the probability that an individual will live to that age. Table 11 indicates that the difference in lifetime

TABLE 11

LIFETIME INCOME (EARNINGS) BASED ON ARITHMETIC MEANS FOR MALES IN SELECTED AGE GROUPS, BY YEARS OF SCHOOL COMPLETED FOR THE UNITED STATES; 1939, 1946, 1949, 1956, and 1958

Years of School Completed and Age	1939	1946	1949	1956	1958
		$	$	$	$
Income from age 25 to death					
Elementary:					
Total	NA	87,004	104,998	143,712	142,808
Less 8 years	NA	74,369	91,095	123,295	120,965
8 years	NA	98,702	122,787	168,004	169,976
High School:					
1-2 years	NA	107,940	141,870	192,254	198,881
4 years	NA	135,852	174,740	237,776	241,844
College:					
1-3 years	NA	161,699	201,938	281,553	305,395
4 years or more	NA	201,731	286,833	391,992	419,871

Source: H. P. Miller, "Annual and Lifetime Income in Relation to Education: 1939-59," American Economic Review, L (December, 1960), Table 11, p. 981.

income of a college graduate and a high school graduate was expected to be, in 1949, about $111,000. By 1958, this difference in lifetime income had increased to approximately $178,000.

Miller's table also indicates that the more highly educated groups have made the greatest relative gains in lifetime income in the years since 1939. The incomes of college graduates have thus been rising more rapidly than those of persons with less education, which suggests that the lower the level of schooling the flatter the profile of average earnings by age. That is, a worker with a limited education can usually expect to attain his peak earnings within ten or fifteen years of entry into the labor force. On the other hand, university graduates may work for thirty years before maximum earnings are reached. The following table summarizes average earnings of the current Canadian labor force by age and level of schooling.

The statistics indicate that not only are absolute earnings higher the higher the amount of schooling but the distribution of earnings by age indicates that the higher the level of schooling the greater the earnings differentials between the older and younger age groups in the labor force.

Chart 1 plots the ratio of average income from employment for the age groups 35-64 to average income from employment

TABLE 12

AVERAGE INCOME FROM EMPLOYMENT BY AGE AND LEVEL OF SCHOOLING FOR YEAR ENDING MAY 31, 1961: MALE NON-FARM LABOR FORCE

Age	Elementary Only	Secondary 1-3 years	Secondary 4-5 years	Some University	Some University
15-24	$1,928	$2,206	$2,497	$1,868	$3,408
25-34	3,311	4,147	4,760	5,108	6,909
35-44	3,653	4,629	5,779	6,608	9,966
45-54	3,648	4,756	6,130	6,882	10,821
55-64	3,480	4,588	5,944	6,731	10,609

Source: DBS, 1961 Census of Canada, Population Sample: Incomes of Individuals, Vol. IV, Table B.6, p. 6.1.

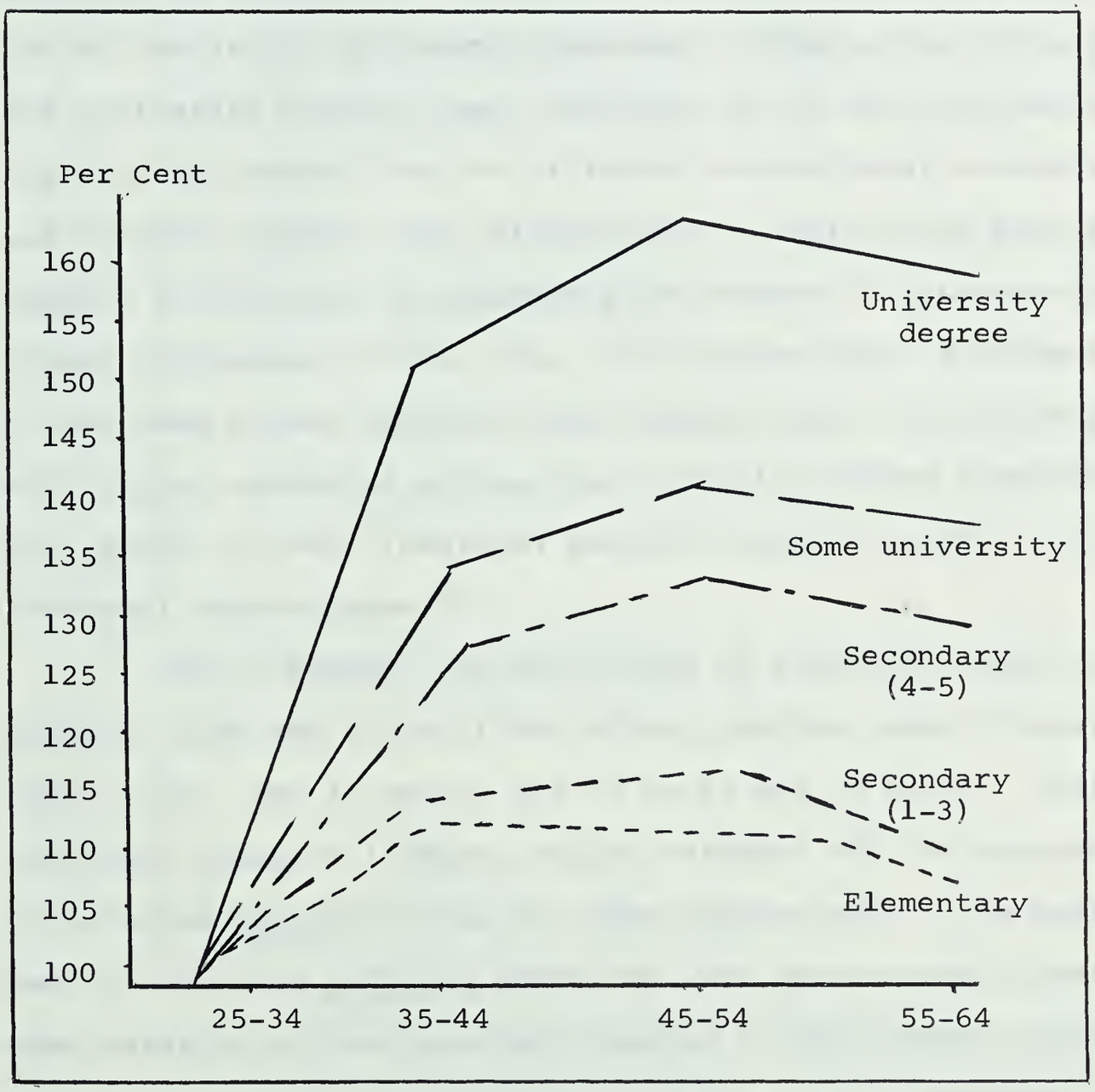
of those aged 25-34 with respect to the levels of schooling indicated in Table 12. The chart clearly illustrates that as one moves from lower to higher levels of schooling the greater are the earning differentials between the older and younger age groups.

The occupations which show the most marked differentials in earnings by age are the occupations which require higher levels of schooling. Education appears to be an important factor in the explanation of inter-occupation and inter-age earnings differences.

Table 13 indicates that considerable variation in earnings occurs between occupations even where persons have

CHART 1

RATIO OF AVERAGE INCOME FROM EMPLOYMENT BY AGE GROUPS TO AVERAGE INCOME FROM EMPLOYMENT FOR AGE GROUP 25-34 BY LEVEL OF SCHOOLING MALES IN CURRENT LABOR FORCE 1961



Source: DBS, Earnings and Education, by J. R. Podoluk, (December, 1965) Chart 1, p. 44.

similar education. Probable lifetime earnings for university graduates range from a low of $133,311 for a clergyman to $583,535 for a physician or surgeon. Similar variations exist among those with only elementary schooling where lifetime earnings in managerial occupations are approximately $200,000 but as low as $67,000 among fishermen, trappers and hunters. The statistics provide some indication as to the difference in the average income flows to different occupational categories and further suggests that differences in ability may partially explain differences in earnings with respect to intra-occupational differences rather than inter-occupational differentials. It has been argued that the high earnings paid to individuals with higher education is due, not to their greater productivity but rather to their insulated position created by their professional associations.[23]

The "lifespan" can be defined in different ways--for example, from age 15 until the oldest possible age of survival (100 or so), age 15 to 65, age 25 to 65 and so forth. While the whole possible lifespan may be suitable for the measurement of lifetime income it does not seem appropriate to the measurement of lifetime earnings where the time period should bear some relation to the possible duration of the working career.

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[23] Milton Friedman and Simon Kuznets, Income From Independent Professional Practice (New York: NBER, 1945).

TABLE 13

LIFETIME EARNINGS BASED ON ARITHMETIC MEANS FOR MALES AGED 25-64 BY YEARS OF SCHOOLING COMPLETED, YEAR ENDING JUNE 1, 1961

	No Schooling or Elementary	Secondary 1-3 years	Secondary 4-5 years	Some University	University Degree
All occupations	$131,126	$168,257	$209,484	$232,448	$353,624
Managerial occupation	200,957	232,718	283,810	315,637	423,328
Managers, specified	198,306	229,703	266,760	282,355	355,868
Owner, managers	201,132	233,177	287,147	321,828	431,322
Manufacturing	223,516	273,880	341,497	382,789	490,671
Construction	222,149	246,363	296,846	339,942	472,533
Utilities	247,010	255,704	292,606	317,867	418,236
Wholesale trade	218,623	261,635	314,244	339,909	448,998
Retail trade	177,769	201,770	245,657	266,662	348,889
Real estate	277,364	297,781	322,443	380,923	467,382
Community	172,267	193,287	248,195	291,024	414,757
Public administration	183,105	192,131	218,575	241,341	327,516
Professional	171,359	195,985	224,094	225,474	354,143
Engineers	--	227,803	260,786	280,328	336,566
Physical scientist	--	--	--	--	318,288
Biologist	--	--	--	--	281,466
Teachers	172,697	172,269	207,284	214,964	301,067
Professors	--	--	--	--	357,773
School teachers	--	178,636	206,971	214,825	286,314
Health	171,740	172,803	187,778	187,778	497,846
Doctors	--	--	--	--	583,535
Dentists	--	--	--	--	402,566
Law	--	--	--	--	468,154
Lawyers & Notary	--	--	--	--	469,394
Clergy	92,081	105,639	107,367	113,779	133,311

TABLE 13--Continued

	No Schooling or Elementary	Secondary 1-3 years	Secondary 4-5 years	Some University	University Degree
Artist, writer	$155,937	$212,661	$236,829	$256,087	$260,883
Other professionals	180,640	199,632	227,461	224,048	315,756
Architects	--	--	--	--	402,819
Accountants	--	229,623	258,684	259,078	349,823
Social Workers	--	156,758	181,036	168,146	215,752
Clerical occupation	134,674	149,782	160,573	159,867	172,995
Sales occupation	142,392	175,234	209,534	216,961	255,850
Service, Recreation	112,255	142,282	164,420	191,245	245,343
Transport	135,614	160,604	182,961	196,172	--
Supervisors	162,355	180,426	194,790	--	--
Operators rail	192,118	200,747	203,164	--	--
Operators water	139,561	185,116	204,970	--	--
Operators road	126,774	141,757	145,476	--	--
Others	120,929	149,149	--	--	--
Others commun.	125,223	152,385	177,236	--	--
Farm Workers	69,498	92,601	101,122	--	--
Loggers & others	66,941	122,719	141,836	--	--
Fishermen	66,941	100,793	--	--	--
Miners	150,288	171,731	185,164	--	--
Craftsmen	135,474	157,451	170,676	169,593	194,392
Millers	125,716	138,117	144,798	--	--
Tire builders	141,098	154,479	--	--	--
Leather	104,477	116,028	--	--	--
Spinners	113,159	124,811	--	--	--
Tailors	121,256	135,430	139,020	--	--
Carpenters	111,363	131,914	139,166	131,189	--

TABLE 13--Continued

	No Schooling or Elementary	Secondary 1-3 years	Secondary 4-5 years	Some University	University Degree
Paper makers	$161,920	$182,038	$195,619	--	--
Printers	181,088	196,041	198,309	--	--
Furnacemen	154,861	162,678	172,739	--	--
Machinists	147,797	160,937	167,578	166,043	--
Mechanics	140,045	155,715	162,737	165,415	--
Electricians	154,756	174,419	184,577	179,012	--
Painters	114,031	123,942	124,507	--	--
Bricklayers	127,406	151,670	168,515	--	--
Glass workers	133,108	149,553	--	--	--
Longshoremen	114,340	130,423	143,457	--	--
Trackmen	116,525	127,631	--	--	--
Labourers, n.e.s.	114,175	111,657	118,079	--	--

Source: DBS, Earnings and Education, by J. R. Podoluk, (December, 1965), Table 20, pp. 57-58.

Restricting estimates to the age groups 25-64 has the advantage of measuring career earnings during those years when formal training is complete and before withdrawals from the labor force began to be important.

Estimating earnings over longer periods of time would alter the relationship between the earning of those with lower levels of education and those with higher levels; measuring earnings from the age 18 or 19 rather than the age of 25 would raise the aggregate earnings of the less educated to a greater extent than those of the more highly educated since the lower the level of education the lower the age at which full time labor force participation starts and at which regular earnings begin to accrue. If estimates of earnings beyond the age of 65 are included, more would be added to the earnings of the more highly educated as their earnings are less affected by aging than the earning of the less skilled.

Bowman has suggested that a better approach to the measurement of lifetime earnings would be to make an adjustment for the probability of labor force participation as well as for mortality.[24]

Table 14 indicates the participation rates of the male labor force by age and school in Canada in 1961. The

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[24]Mary Jean Bowman, "Human Capital: Concepts and Measuring," Economics of Higher Education, ed. Selma J. Mushkin (Washington: U.S. Department of Health, Education and Welfare, Office of Education, 1962), p. 85.

TABLE 14

PARTICIPATION RATES BY AGE AND SCHOOLING--MALES, 1961

Age	No Schooling or Elementary	Secondary 1-3 years	Secondary 4-5 years	Some University or Degree
15-19	46.8	35.4	37.1	54.1
20-24	85.0	92.0	88.5	72.0
25-34	90.7	95.9	96.9	94.9
35-44	90.0	96.0	97.2	98.0
45-54	88.8	94.3	95.8	96.8
55-64	79.1	85.1	87.0	89.9
65 and over	25.8	32.6	34.5	43.7

Source: DBS, Earnings and Education, by J. R. Podoluk, (December, 1965), Table 19, p. 56.

rates show that labor force participation rises as the level of schooling rises except in the younger age groups for the higher levels of education which reflect the fact that some cohorts are still attending school.

Table 15 presents estimates of lifetime earnings of males in the non farm labor force and in selected occupational categories adjusted for mortality but not for labor force participation.

The data confirm that measurement of earnings from the age of 15 rather than the age of 25 reduces the differential

TABLE 15

LIFETIME EARNINGS--MALES FOR SELECTED AGES AND SELECTED LEVELS OF SCHOOLING, 1961

Schooling	Age		
	15-64	19-64	25-64
	$	$	$
Elementary 5-8	151,820	148,449	137,230
Secondary 4-5	221,700	222,676	209,484
University degree	356,108	357,657	353,624

Source: DBS, Earnings and Education, by J. R. Podoluk, (December, 1965), Table 21, p. 59.

between the earnings of the low and high schooling categories.[25]

Education and Discounted Lifetime Earnings

Houthakker, using the same basic data as Miller, has computed mean incomes in 1949 by age and years of schooling both before and after taxes.[26] He then weighted these figures to reflect mortality rates, thus providing estimates for expected lifetime incomes for persons with various levels of education. Houthakker then discounted these lifetime incomes back to age 14 using discount rates of 0,3,6, and 8 percent

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[25] Supra, p. 34.

[26] H. S. Houthakker, "Education and Income," Review of Economics and Statistics, XLI (February, 1959), 24-28.

and the general formula $C_t = \frac{E_t}{(1 + r)^t}$

C_t = "present value" of the future income in year t

E_t = future earning in year t

r - rate of interest

The raison d'etre is that the longer the waiting period involved before benefits return the lower the present value of such returns, and also the higher the probability of intervening events preventing the realization of higher returns. In addition, the present values calculated at the commencement of schooling implicitly reflect opportunity costs by assigning zero earnings to the years of schooling. Discounting to age 19 (university entrance) then, has this cost element for university graduates but not for elementary and high school graduates. Discounting to age 15 (high school entrance) implicitly includes these costs for high school graduates as well.

Because of the differences in age, education and earning profiles, if the value of lifetime earnings is discounted by some discount rate to provide estimates of present value at some fixed age such as 14, 19 or 25, the relative differences between the values of lifetime earnings for different education groups shrink.[27] The higher the

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[27] Supra, p. 30.

discount rate used the smaller the differences. The choice of rates to be used is usually arbitrary. Houthakker's results are shown in Table 16.

We are interested in the difference between any two entries in a given column of Table 16. Consider, for example, the individual who is contemplating four years of college after finishing high school. Using a discount rate of 8 percent, the present value of the extra earnings before taxes, resulting from a college education is $5,095 (i.e., $30,-085-$24,990). In other words, the amount of money which a person would have had to invest at 8 percent at age 14 (in 1949) so that he could receive a stream of receipts precisely equal to the stream of extra earnings he would receive because of his choice of a college education is $5,095.

Table 17 shows the present value of the lifetime earnings of Canadians as shown in Table 15.

Once again using a discount rate of 8 percent the present value at age 15 of extra earnings before taxes in Canada, resulting from a college education is $11,662($47,914-$36,252).

It should be noted that the United States figure of extra earnings of $5,095 is in 1949 dollars while the Canadian figure of $11,662 is in 1961 dollars. However, these estimates indicate that, because of the differences in age, education and earnings profiles, the extent of the earnings advantage

TABLE 16

PRESENT VALUE AT AGE 14 OF LIFE-TIME INCOME BY YEARS OF SCHOOL COMPLETED

Years of School Completed	Discount Rate 0%	3%	6%	8%
BEFORE TAX				
Elementary:				
0	64,132	26,220	13,014	8,896
1-4	79,386	33,939	17,492	12,179
5-7	100,430	42,758	21,834	15,098
8	124,105	52,923	27,037	18,700
High School:				
1-3	142,522	59,734	30,008	20,514
4	175,160	72,475	36,328	24,990
College:				
1-3	198,268	78,138	36,547	23,793
4 or more	280,989	106,269	47,546	30,085
AFTER TAX				
Elementary:				
0	60,785	24,944	12,428	8,515
1-4	75,021	32,189	16,638	11,730
5-7	93,571	40,006	20,537	14,252
8	115,277	49,425	25,380	17,592
High School:				
1-3	130,933	55,260	27,945	19,188
4	157,940	66,055	33,466	23,149
College:				
1-3	175,206	69,651	32,912	22,400
4 or more	238,761	91,335	41,432	26,454

Source: H. S. Houthakker, "Education and Income," Review of Economics and Statistics, XLI (February, 1959), Table 3, p. 28.

TABLE 17

DISCOUNTED LIFETIME EARNINGS

Schooling	Discount Rate 0%	3%	5%	8%
Males aged 19-64				
Elementary 5-8	$148,449	$ 74,275	$ 54,534	$35,330
Secondary 4-5	222,676	108,626	78,114	49,321
University degree	357,675	164,115	112,100	65,187
Males aged 15-64				
Elementary 5-8	152,473	72,720	48,424	29,301
Secondary 4-5	221,700	100,671	64,264	36,252
University degree	356,108	151,852	92,225	47,914

Source: DBS, Earnings and Education, by J. R. Podoluk, (December, 1965), Table 22, p. 59.

of the highly trained can differ substantially if present value is examined rather than the undiscounted income stream. The degree of difference is affected by the interest rate used and the age span for which discounts are calculated.

The question now arises as to the extent to which this contribution does or does not exceed the costs of securing the additional education.

CHAPTER IV

CONCEPTUAL PROBLEMS WITH HUMAN CAPITAL MEASUREMENT

In considering the cost aspect of education, we should view it from two perspectives: (1) the social product or the national productivity orientation; and (2) the private product or personal profit orientation. The social product has three major components: (1) school costs incurred by society such as teachers' salaries, supplies, interest, and depreciation on capital; (2) opportunity cost incurred by the individual, namely, income foregone during shcool attendance; and (3) incidental school-related costs incurred by individuals, for example, books and travel. The private product includes; (1) tuition and fees paid by the individual; (2) opportunity costs; and (3) incidental school-related costs.

Measuring the Costs of Education

Schultz has tabulated total resource costs of education by society in the United States between selected years 1900 and 1956.[28] He also estimates the foregone

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[28] T. W. Schultz, "Capital Formation by Education," JPE, LXVIII (December, 1960), 571-83.

earnings of students adjusted for unemployment in the same period. Incidental school-related costs were assumed to be 10 percent of foregone earnings. Table 18 shows Schultz's figures for total social product cost per student per year of college and in 1950 this amounted to $2,365. While Schultz does not give us private product cost, Hansen does.[29] His calculations of private product costs per student in college in 1949 are (1) tuition and fees $245; (2) earnings foregone $1,349; (3) incidental costs $142; and (4) total $1,736. Hansen's 1949 earnings foregone figure is just slightly less than Schultz's 1950 figure (i.e., $1,349 vis-a-vis $1,422).

Average tuition per single college student in Canada in 1961 was $388.00.[30] Books and incidental school-related costs average $164.00.[31] Therefore private direct costs were $552.00 of which 70% was tuition and fees.

The indirect or opportunity costs depend upon the number of hours available, for part time work as well as the opportunities for part-time summer employment. The latter

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[29]W. Lee Hansen, "Total and Private Rates of Return to Investment in Schooling," JPE, LXXI (April, 1963) 128-40.

[30]Canada, DBS, Education Division. University Student Expenditure and Income in Canada, 1961-62, Part II, (Ottawa: Queen's Printer, August 1963), p. 38.

[31]Ibid.

TABLE 18

TOTAL RESOURCE COSTS PER STUDENT PER YEAR OF COLLEGE 1900-1956 (Dollars)

Year	School Costs	Earnings Foregone	Incidental Costs	Total
1900	170	192	19	381
1910	228	259	26	513
1920	308	626	63	997
1930	486	509	51	1,046
1940	498	537	54	1,089
1950	801	1,422	142	2,365
1956	1,168	1,943	194	3,305

Source: T. W. Schultz, "Capital Formation by Education," JPE, Vol. LXVIII (December, 1960), Table 6, p. 580.

determinant is quite sensitive to business conditions and the age, sex, year of schooling etc. of students, so indirect costs vary substantially more over time than direct costs do.

Table 19 gives an estimate of foregone earnings of individuals not in the current labor force and in the age bracket of 15-24 years; the average earned income for males was $898 and females was $851. This income figure is in line with the income figure calculated on the assumption (following Schultz) that university attendance is a full-time occupation for two-thirds of a year, September to April, with

TABLE 19

TOTAL INCOME FOR INDIVIDUALS
NOT IN THE CURRENT LABOR FORCE
YEAR ENDED MAY 31, 1961

Canada	Average Income	
	Male	Female
All ages, 15 & over	2,064	1,013
15-24	898	851
25-34	2,396	1,127
34-44	2,959	950
45-54	2,789	1,005
55-64	2,745	1,250
65-70	3,288	1,551
70 and over	2,899	1,922

Source: DBS, 1961 Census of Canada, Population Sample: Incomes of Individuals, Vol. IV, Table B.8, p. 8-1.

vacations occupying the remaining third, May to August. The potential earnings of students during the first four years of university can be assumed to be equal to the actual earnings of "equivalent" high school graduates in the same age class.

Table 20 shows that male cohorts having completed secondary education and between the ages of 20-24 have annual earnings of $2,787. These statistics are derived

from the average annual earnings reported by members of the current labor force rather than rates of pay of the current labor force and thus these are realized earnings. This implicitly allows for the loss of earnings because of unemployment, illness or other factors which result in the loss of earnings during the year.[32] The student could have earned one-third or approximately $900 based on this criterion. Table 20 also suggests that the average earned income of university students prior to permanently entering the labor force is $755 as indicated in the age class 15-19 years. It is a reasonable assumption that a cohort in this age bracket with some university training must still be attending school. We shall use the figure $898 in our calculations of total private cost because students typically forgo career oriented jobs which have lower starting salaries, but which will attract high school graduates, for laboring jobs with higher wage rates. Foregone earnings are the earned income which the cohorts may have made ($2,787) less any realized earned income $898 from part-time or summer employment. The resultant figure $1,889 is the estimate of foregone earnings in 1961.

In summary, total private costs of attending university in the year 1961 are (1) tuition and fees $388, (2) books and

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[32] Bowman, op. cit., p. 81.

TABLE 20

WAGE-EARNERS BY SCHOOLING, AGE GROUP AND SEX, SHOWING AVERAGE EARNINGS, JUNE 1, 1961

Canada	Average Earnings	
	Male	Female
ELEMENTARY	2,964	1,449
15-19 years	1,123	954
20-24 years	2,156	1,394
25-34 years	3,035	1,550
35,44 years	3,312	1,560
45-54 years	3,285	1,518
55-64 years	3,168	1,188
65 years and over	2,360	1,188
SECONDARY	3,911	2,078
15-19 years	1,178	1,226
20-24 years	2,787	2,108
25-34 years	4,116	2,291
35-44 years	4,677	2,227
45-54 years	4,778	2,353
55-64 years	4,562	2,434
65 years and over	3,396	1,846
UNIVERSITY	5,699	3,257
15-19 years	755	862
20-24 years	2,255	2,413
25-34 years	5,408	3,399
35-44 years	7,122	3,682
45-54 years	7,372	4,080
55-64 years	7,031	4,186
65 and over	5,177	2,812

Source: DBS, 1961 Census of Canada, Labour Force: Earnings of Wage Earners by Schooling and Age, Vol. III (Part 3), Table 17, p. 17-1.

unusual living expenses $164, and (3) foregone earnings $1,889 which totals $2,441. Foregone earnings account for about 77 percent of the total, tuition and fees only about 16 percent, and other direct costs the remaining 7 percent. Therefore, if tuition and fees alone were eliminated, that is if universities were made "free", only a relatively small part of the burden of the private costs of attending university would be eliminated.

The consumption versus investment problem.--Since education adds more to the student modus vivendi than just his potential economic productivity, the economist should make some type of estimation of this increased cultural contribution or the so called "better life" available to him.

A consumption function is generally thought of in terms of "current" and "durable" consumption. Current consumption within the education context would suggest the intrinsic enjoyment of present attendance at school, while durable consumption would imply the value orientation and appreciation of the "better life" now attainable through the increased horizons opened to the student.

The investment aspect of education is primarily concerned with the rates of return in lifetime earnings attributable to different levels of education.

Accepting the tenet that education is a source of present and future pleasure (i.e., consumption), how should estimates of direct monetary returns be adjusted to take account of such considerations?

In calculating a rate of return figure, Schultz has argued that the consumption component of educational costs should be identified, and then subtracted from the total educational costs in order to arrive at an investment cost estimate which can be used with earnings data to calculate the rate of return on the investment portion.[33]

The obvious problem is how does one identify the consumption component of educational costs where the complementarity between consumption and investment are extremely high. The rewards associated with a growing awareness of ones proficiency and of the enjoyment of associating with specialists in ones chosen field goes hand in hand with the challenge of learning.

Private Product Money Gains

Hansen calculated the private rate of return for a four year college education before tax at 12.9 percent and after taxes at 11.5 percent.[34] Becker found the private

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[33]T. W. Schultz, "Investment in Human Capital," AER, LI (March, 1961), 12-13.

[34]Hansen, op. cit., Table 6, p. 138.

rate of return before tax to be more than 12 percent to the cohorts of white male college graduates.[35] The gains from education should be compared with returns from investments with equally large risk and illiquidity. Becker indicates that the variation in the rate of return from corporate manufacturing investments is of the same general magnitude as that from college education both yielding approximately 12 percent. Stigler, however, estimates the average rate of return on corporate manufacturing investments at a little over 7 percent.[36] A reasonable inference would then be that the private money gain in the United States from college to the typical graduate is as great as what could have been obtained by investing elsewhere.

The aforementioned studies are based upon cross-sectional data and for estimates of lifetime earnings the assumption is made that a cohort receives the average earnings shown by cross-sectional data for that age, adjusted for mortality rates, and educational category. The aggregate earnings of the survivors are calculated by multiplying the number of survivors by the average earnings. The aggregate earnings are then summed for the life span used and divided

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[35]Gary S. Becker, Human Capital (New York: NBER, 1964), p. 114.

[36]G. J. Stigler, Capital and Rates of Returns in Manufacturing Industries (Princeton: NBER, 1963), p. 34.

by the original number of persons to arrive at average lifetime earnings.

Table 21 shows the hypothetical average earnings of Canadian males age 19 estimated by the method described above. These statistics will be used for earnings differentials in the calculation of the rates of return rather than the actual average earning shown in Table 12.

TABLE 21

HYPOTHETICAL EARNINGS ESTIMATED FROM CROSS-SECTIONAL DATA, 1961 CENSUS OF CANADA

Age	Elementary 5-8 years	Secondary 4-5 years	University Degree
	(1)	(2)	(3)
	$	$	$
19	1,550	1,600	--
20	1,797	1,997	--
21	1,994	2,493	--
22	2,240	2,837	--
23	2,410	3,081	3,528
24	2,530	3,373	4,067
25-34	3,363	4,679	6,796
35-44	3,670	5,566	9,606
45-54	3,542	5,643	9,966
55-64	3,018	4,842	8,640

Source: DBS, Earnings and Education, by J. R. Podoluk, (December 1965), p. 69.

Average Income from Employment by Age and Level of Schooling

It should be noted that a person working the full life span who receives the average earnings of his particular group would have realized higher lifetime earnings than earnings shown in the hypothetical case in Table 21. This is so because average lifetime earnings are the probable average earnings over a specified time period per person entering employment at a specific age, not average lifetime earnings over a specified time period per person surviving for the complete length of the time period.[37]

Rates of return analysis compare income benefits from education with the estimated costs incurred in obtaining the education. The benefits derived are the additional income flows which accrue from possessing more education, for example, with completion of a university degree the returns to the extra education would be the difference between the average earnings per person with a university degree minus the average earnings per person with a high school diploma for the various age groups.

Becker in determining his 12 percent rate of return treats the costs of schooling as negative income while the cohort attends school. The internal rate of return is that

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[37]Bowman, op. cit., p. 86.

TABLE 22

PRIVATE ANNUAL COSTS OF UNIVERSITY AND HIGH SCHOOL MALES, 1961

UNIVERSITY

Age	Earnings Foregone	Less Scholar-ships	Tuition	Books	Transpor-tation	Total
	$	$	$	$	$	$
19	1,042	-125	409	97	70	1,493
20	1,075	-125	409	97	70	1,526
21	1,571	-125	409	97	70	2,022
22	1,915	-125	409	97	70	2,366

SECONDARY SCHOOLING

Age	Books	Earnings Foregone	Total
	$	$	$
15	25	700	725
16	25	899	924
17	25	1,098	1,123
18	25	1,321	1,346

Source: Compiled from DBS, Earnings and Education, by J. R. Podoluk, (December, 1965), Tables 17 and 18, p. 54.

discount rate which yields a present value of zero for the net income stream derived from the additional education.[38]

Following Becker, Table 22 shows the net earnings foregone by age of male student estimated by the method shown

[38]Becker, op. cit., p. 39.

in an earlier section of this chapter.[39] In addition high school costs were assumed to consist only of expenditures on books plus earnings foregone, while university costs were calculated as earnings foregone minus money received through bursaries and scholarships plus direct costs of schooling--tuition, books, supplies and transportation cost of students whose normal residence was not in the same city.

The figures in Table 23 show the estimated earnings differentials for male cohorts who have completed high school and university as calculated from Table 21. For high school graduates the earnings differentials are those between high school (secondary) graduates and cohorts with elementary schooling, for example for the age 19 column 2 minus column 1 ($1,600 - $1,550 = $50). The university graduates' differential is that between the university graduates and cohorts with secondary schooling, for example, for the age 23 column 3 minus column 2 ($3,528 - $3,081 = $447). The negative entries are the costs of schooling determined in Table 22.

The foregoing calculation of the private rate of return for a four year college education in Canada before taxes is 19.7 percent, and for high school is 16.3 percent.

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[39] Supra, p. 42.

TABLE 23

ADDITIONAL INCOME FROM EMPLOYMENT RECEIVED BY MALES FOR YEAR ENDED MAY 31, 1961 AS A RESULT OF COMPLETING SELECTED LEVELS OF SCHOOLING

Age	Secondary 4-5 years	University Degree
	$	$
15	-725	--
16	-924	--
17	-1,122	--
18	-1,346	--
19	50	-1,493
20	200	-1,526
21	499	-2,022
22	597	-2,366
23	671	447
24	763	694
25-34	1,316	2,117
35-44	1,896	4,040
45-54	2,101	4,323
55-64	1,824	3,798
Rate of return	16.3%	19.7%

Source: Based on DBS, Earnings and Education, by J. R. Podoluk, (December 1965), Table 23, p. 61.

These figures are substantially higher than the 12 percent American rate of return figure mentioned earlier.[40]

[40] Supra, p. 49.

In addition, the rate of return for an investment in a university education in Canada appears to be higher than an investment in a high school education. These findings do not coincide with Hansen's and Becker's results in the United States where higher rates of return accrue to high school graduates.[41]

Hansen in his treatment of rates of return to investment in schooling treats the costs of education as an investment rather than negative income as Becker does. The internal rate of return is then estimated by finding that rate of discount that equates the present value of the cost outlays (investment) with the present value of the additional income flows.[42]

Table 24 illustrates this method of calculation. The figures in column 1 are the cost or investment required by an elementary school graduate as indicated in Table 23. Column 2 represents the net earnings differentials between a university degree and an elementary school education, for example, for the age 23 the additional income is determined by summing column 1 and column 2 of Table 23 ($671 + $447 = $1,118).

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[41]Hansen, op. cit., p. 138, and Becker, op. cit., p. 128.

[42]Hansen, op. cit., p. 138.

TABLE 24

COSTS AND RETURNS TO ELEMENTARY SCHOOL GRADUATES FROM COMPLETION OF ELEMENTARY SCHOOL TO COMPLETION OF UNIVERSITY

Age	Cost or Investment	Additional Income
	$	$
15	725	--
16	924	--
17	1,122	--
18	1,346	--
19	1,493	--
20	1,426	--
21	2,022	--
22	2,366	--
23	--	1,118
24	--	1,457
25-34	--	3,433
35-44	--	5,936
45-54	--	6,424
55-64	--	5,622
Rate of return	17.1%	

Source: Based on DBS, Earnings and Education, by J. R. Podoluk, (December 1965), Table 24, p. 62.

The resultant rate of return is 17.1 percent which reinforces the previous figures determined by Becker's approach.

In summary the results obtained from the studies on human capital do offer rather consistent support that higher education has paid significant returns. The evidence suggests that individuals with the required ability should continue their education through university.

Evaluation of Comparative Rates of Return

Calculations for Canada have shown that private returns on the human investment in high school and university education are in the range of 16 to 20 percent per year, with slightly higher rates for an investment in a university education than in a high school education.

If one wishes to make inter-country comparisons on the assumption that U.S. experience can serve as a reasonably reliable guide for Canadian performance, some caution must be exercised in utilizing the calculations. In particular, attention would have to be paid to the method and size of adjustments made in the two countries regarding the following:

1. The conversion of Canadian incomes from a before-tax to an after-tax basis.
2. The estimation of the relative percentage of social and private costs of high school and university borne by all levels of government in the two countries. The implication is that the individual whose school related costs are subsidized to a greater extent bears

a smaller burden of private costs thus enhancing the resulting lifetime net earnings calculated on private costs.

3. The investigation of the inter-country salary profiles over time. There is some indication that the profiles varied significantly such that the Canadian cohort in the earlier age group of 25-34 years was paid an approximately equivalent salary as the U.S. counterpart; however, as the time horizon lengthens, a differential between the inter-country earnings arises in favor of the U.S. cohort, and hence the present value of the lifetime earnings would be weighted in favor of the Canadian. Such would suggest a prevailing rate of return disproportionally high for the Canadian data. This hypothesis depends on the assumption that in the age group 25-34 the Canadian cohort's earnings are above his marginal physical product in the short run. (This must be so if he is being paid a salary equivalent to his U.S. counterpart who is reputedly 20-25 percent more productive.) This situation could arise in response to a demand for young university graduates by industry which realizes that Canada has, in the recent past, experienced a relatively slower development and adoption

of industrial and technical knowledge, and of professional management.

Further research is needed to clarify such comparisons of Canadian and U.S. rates or return.

Social Product Gains

The social economic gain from education, i.e., the gain to society as opposed to individuals differs from the private gains in part by the differing costs but also due to the different effects on earnings and productivity. A student generally needs only to determine the effect of a university education on his earnings, but society needs to determine its effect on national income.

The social product consideration is based on the premise that in a market economy differences in earnings reflect differences in productivity. This being the case then an investigation of earnings-to-education differentials would presumedly indicate the effects of education on the output of the country and would thereby suggest whether society as a whole is investing the right share of its resources in education. We should, by utilizing this technique of analysis, be able to determine the relationship of educational benefits to educational costs in such a way so as to provide some information concerning the adequacy of the social rate of return on college education.

One difficulty of this approach is that earnings are thought to greatly understate the social productivity of college graduates because they are (allegedly) only partly compensated for their effect on the development and spread of economic knowledge. In technical language, social returns are said to be larger than private returns because of the external economies produced by college graduates.

The economist uses the term external economies to describe those benefits which accrue to society as a whole, and in this particular context due to the educational institution. These are benefits which exist through advances in knowledge and techniques which facilitate economic growth. These may be either economic, social or political benefits of education such as greater understanding of the underlying factors contributing to economic growth; poverty; or simply a better informed electorate.

Becker calculates a lower limit to the social effect of education of 12.5 percent or approximately the same as the private return.[43] Denison, however, by attributing all of the residual to education or what he calls "advancement in knowledge" determines an upper limit at 25 percent.[44]

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[43]Becker, op. cit., p. 118.

[44]Denison, op. cit., p. 271.

The difference in the range between 25 and 12.5 percent is a measurement of the ignorance of external effects.

Becker determines a first approximation to the social rate of return on business capital as being in the neighborhood of 8 and 12 percent.[45] At the same time he makes adjustments for differential ability of students with respect to the lower 12.5 percent limit of the social rate of return on education and arrives at a first approximation rate for college entrants of between 8 and 11 percent. The rates on business capital and college education seem, therefore, to fall within the same range. Ignorance about the residual, however, precludes at present any firm judgement about the relative social rates on business capital and college education.

Some Limitations of Estimates of Rates of Return

The statistics upon which the analysis depends are based on cross-sectional data. Since substantial increases do occur in earnings over time, some upward adjustment should possibly be made to earnings, ipso facto. Rates or return greater than the estimates based on the assumption of unchanging earnings would result.

Throughout the analysis there is the implicit assumption that the relative earnings of different education groups

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[45]Becker, op. cit., p. 120.

will remain unchanged. In the long run this assumption is likely invalid due to the rapid change in knowledge and technology. Thus the earnings differentials between varying educational groups could narrow or widen resulting in lower or higher returns to private investment in higher education.

Since education possesses the good fortune of longevity on one hand, and yet is a long process in acquiring, one must utilize long time horizons in assessing education's worth.

CHAPTER V

FUTURE RESEARCH NEEDS

Research is a continuing process. Each step forward logically leads to new problems to be solved and new ideas to be tested. The present work is no exception.

There remain many unsettled issues with which the economist with his technical devices, such as marginal analysis, demand elasticity, product differentiation, and comparative advantage can successfully cope with. Some of the issues that are presently left unanswered are:

1. What is the cost, or the benefit, involved in keeping young people off the labor market?
2. Given the multiproduct nature of the "schooling industry" which combines the transmission of knowledge, the creation of new knowledge, and search for talent, what resources should be devoted to these respective goals and where is the "trade-off" between research and development and teaching?
3. Are innovation, research and development, and the improvements in skill and knowledge of the labor force a prerequisite or consequence of economic growth?

Limitations and Recommendations

It has been suggested that there is serious danger of exaggerating the monetary return of a university education and that the influence of other factors, such as higher ability levels, home environment, achievement-motivation and income have not been adequately recognized in the larger income of college graduates. The statistical analysis presented in Chapter 11 on the relationship between earnings and education indicates that the contribution of additional education to earnings is significant.[46] Education, however, is only one of the many factors that determine earnings; both earnings and education may be related to more fundamental traits and therefore the relationship between higher education and earnings may be spurious and what essentially may remain undisclosed are the underlying causes of both advanced education and increased earnings.

Since a number of socio-economic factors other than education do affect the earnings of an individual, some caution must be exercised in attributing huge monetary gains to education, per se. Further research aimed at removing the effect of factors other than education in the determination of private returns is needed.

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[46] Supra, p. 29.

Perhaps the greatest difficulty in examining the contribution of various factors to economic growth is the very strong complementarity among the factors. In particular, it is quite clear that the effects upon GNP of the three principal contributors to growth of total factor productivity--technological change, improved education, and improved allocative efficiency--should not be viewed as independent.

Educated people, particularly scientists and engineers, are a critical input to the research and development process; thus the rate at which technological understanding is increased is strongly related to the number of educated people applied to that purpose. Moreover, new technological developments need to be evaluated by people in management who can understand them and their potential market, thus the return to many educated people is in part, a function of technological change. Finally, if a high level of education is essential to create technological change, a basic education is essential to permit people to adjust to it through training programs in order that they may learn to perform new jobs. At lower levels as well as at higher levels, the returns to education are strongly affected by the pace of technological change.

A purported limitation of the analysis is the assumption that firms tend to employ the labor factor up

to the point where its marginal revenue product equals the wage paid. The argument claims that wages are determined at the bargaining table and through traditional wage structures and differentials, or seniority rules not based on productivity considerations. Admittedly, perfect competition in the labor market does not exist, however, in the long run competitive factors are likely to operate in the economy setting an upper limit to the extent to which wages may rise and still permit a profitable enterprise to continue operation. Therefore these competitive factors are effective in establishing a wage structure such that wages do broadly reflect differences in the marginal productivity of labor.

A serious limitation in making estimates of net discounted lifetime earnings is that earnings are based on cross-sectional data secured at one point in time. We do not know the actual lifetime earnings of persons with varying amounts of education in different occupations at different time intervals. Substantial increases in real earnings which are measured at different time intervals reflect economic growth which is entirely excluded from the cross-sectional data.[47] Consequently, we have to

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[47]Herman P. Miller, "Lifetime Income and Economic Growth," AER, LV (September, 1965), p. 834.

assume that the available cross-sectional data provides a reasonable approximation of lifetime earnings.

A crucial problem for the demand for education is the extent to which people's attitudes, plans and aspirations are likely to change in the future. The motivations, values and educational attainments of parents today are higher than the previous generation and clearly imply increasing educational attainment and more widely held aspiriation for college education for the present generation. Over the years, the general level of people's concern with education and realization of its importance has grown and will continue to grow so that parents in all situations will tend to be more concerned with their children's education. People are becoming more aware of the personal economic advantage of more education; some are now becoming aware of the national needs for educated personnel, and perhaps the advantages of a liberal higher education may ultimately be more widely appreciated.

CHAPTER VI

CONCLUSION

Economists tend to equate investment with economic growth and are concerned primarily with such matters as savings and investment, national income, productivity and balance of payments.

Growth is, in part, the result of human effort. It takes human agents to mobilize capital, to exploit natural resources, to create markets, and to carry on trade. Human resource development, therefore, is a necessary condition for economic growth. Admitted, however, it does not explain everything. A combination of many factors is required for the long-term growth of real income and productivity. This study hopefully serves to focus attention on some neglected contributing factors--human resources and higher education in our expanding economy.

Human resource development is the process of increasing the knowledge, the skills, and the capacities of the people in the society. It could be described as the accumulation of human capital and its effective

contribution in the growth of an economy. This paper has concentrated on the economic returns to higher education; however, human resources are developed in many ways, only one of which is higher education. Formal education, beginning with first-level education, continuing with various forms of secondary education including commercial and technical institutes and then higher education is the primary method of human resource development. Second, human resources are also developed "on the job" through systematic or informal training programs in employing institutions; in adult education programs; and through membership in various political, social and religious groups.[48] A third process is self-development, as individuals seek to acquire greater knowledge and skills on their own initiative by reading or by taking formal or correspondence courses. The process of education may be both a cause of economic growth and a result of it.[49] Two other processes of human resource development are improvements in the health of the working population through better medical and public health programs, and

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[48]Jacob Mincer, "On the Job Training: Costs, Returns and Some Implications," JPE (supplement), LXX (October, 1962), 50-79.

[49]K. J. Arrow, "The Economic Implications of Learning by Doing," Review of Economic Studies, XXIX (June, 1962), 155-73.

improvements in nutrition, which increase the working capacity of people.[50]

In the attempt to measure the contribution of human resources to a dynamic economy one must bear in mind that technological change has been interpreted in a broad sense so as to include not only the aforementioned changes in the capital stock embodied in men, physical and mental; but also qualitative changes in physical capital, economic organization and structure, communications, and research and development.

A number of different approaches to the relationships between education and economic growth have been discussed. Certain conclusions were reached and these are now summarized stating generalizations pertaining to (1) the effects of education on earnings, (2) the rate of return on investment in education, and (3) the contribution of education to economic growth.

Education and Earnings

Data on annual income for males shows that for all age levels income increases as years of schooling increase. The data also shows an income difference of 43 percent

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[50]Selma J. Muskin, "Health as an Investment," JPE (supplement), LXX (October, 1962), 129-57.

between male high school and college graduates 25-34 years old, and a 72 percent difference of the same group 35-44 years. This income difference is 78 percent in the age class 45-54. Thus the college graduate of any given age not only earns more than persons of the same age with less education, but the earnings of the college graduate exceeds those of other persons to a greater extent as he grows older. The latter statement suggests that the lower the level of schooling the flatter the profile of average earnings by age. That is, a worker with a limited education can usually expect to attain his peak earnings within ten or fifteen years of entry into the labor force, while on the other hand, university graduates may work for thirty years before maximum earnings are reached. In addition, total lifetime earnings increases as education increases and even when lifetime income is discounted, the contribution of additional education to earnings is positive and significant. Education appears to be an important factor in the explanation of inter-occupation and inter-age earnings differences.

The Rate of Return on Investment in Education

Education yields a high rate of return on investment. The economic returns to individuals in Canada is striking.

The before tax private rate of return for a university education is approximately 17 to 20 percent, while the high school rate of return tends to be approximately 16 percent.

The return for an investment in a university education in Canada appears to be higher than the investment in a high school education. These latter findings do not coincide with results in the United States.

The knowledge of private rates of return to education may be useful to guide and to encourage people in their decision to continue their education through university in that the monetary returns exceed the costs of education by a considerable margin. With continued high levels of business activity and the mounting demand for highly trained and competent men in management and many of the professions, the opportunities and commensurate rewards for individuals with higher education seem certain to continue.

The social rate of return on business capital and college education seem to fall within the same range. Thus investment in education contributes to the economic well-being of the nation as a whole.

The Contribution of Education to Economic Growth

Research involving determination of the many different factors which contribute to economic growth

(of which education is one) indicate that increases in years of schooling completed by the labor force have contributed significantly to the growth of the nation. These studies hold promise for the future and seem to be the best known available method for analyzing the sources of economic growth.

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